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Indian Standard

CODE OF PRACTICE FOR CONSTRUCTION OF SUGAR GODOWNS

(*First Revision*)

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 5

October 1983

Indian Standard

CODE OF PRACTICE FOR CONSTRUCTION OF SUGAR GODOWNS

(First Revision)

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Indian Standard

CODE OF PRACTICE FOR CONSTRUCTION OF SUGAR GODOWNS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 28 February 1983, after the draft finalized by the Sugar Industry Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 It has been found that 1·5 to 2·0 percent of the total sugar bags, stored in godowns get damaged to varying degrees depending upon the nature and design of godowns, the manner of storage, etc. In addition, entire sugar stored in godowns undergoes deterioration to varying extent depending on the quality of sugar, the conditions of construction of godowns and the conditions prevailing in the sugar godown.

0.3 There are three primary causes of deterioration, namely, humidity, temperature and micro-organisms.

0.3.1 Of these, moisture is the most significant cause for the spoilage of sugar in godowns and it also controls the effect of micro-organisms and temperature. Sugar is hygroscopic in nature and absorbs moisture when the relative humidity of the atmosphere is high. When the moisture content of sugar increases, it becomes syrupy and sticky on its surface. Moist sugar is more susceptible to deleterious effects of micro-organisms and temperature; its hygroscopicity increases and greater deterioration takes place. An essential condition for preventing deterioration of sugar is, therefore, to maintain low humidity (not more than 60 percent relative humidity) in the godowns. For this purpose, it is essential to so construct the godowns as to arrest the ingress of moisture and enable the humidity inside the godown to be controlled. The entry of moisture into the godown could be from:

a) outside atmosphere, or

b) subsoil water.

0.3.2 During rainy season, the humidity in atmosphere outside the godown is above 85 percent. Through leaks in doors, ventilators, roof, etc, the humid air enters the godown and increases the relative humidity therein. To arrest this, various suggestions have been made in this standard. The ingress of moisture from subsoil water into the godown through the floor and walls of the godown by capillary action is another very important factor in increasing the humidity inside the godown to cause deterioration of sugar. Such ingress of moisture is appreciable in sub-mountanious (*TARAI*) and low level areas, particularly in the rainy season when subsoil water level goes up. The humid-proof floor and walls are, therefore, essential requisites for a sugar godown.

0.4 This standard was first published in 1968 with a view to providing details of the construction of godowns in which humidity inside is not affected by the alteration in the humidity of the outside atmosphere. This revision has been taken up with a view to modifying the requirements in the light of comments received from various construction agencies and organizations implementing the standard.

In this revision a number of changes have been made and prominent amongst them are as follows:

a) Improved damp-proofing treatment has been suggested,

b) Filling of the plinth and floor has been modified,

c) Method of making the godown resistant to earthquake forces has been suggested,

d) Adoption of anti-termite measures has been suggested, and

e) Other requirement which would make the godown structurally stable have been added.

0.5 This code is based on the earlier work on the subject in foreign countries and particularly on the more recent work at the National Sugar Institute, and experience gained with the prevailing practices in the country.

1. SCOPE

1.1 This code covers the requirements and the methods of construction of godowns for storage of bagged sugar.

2. REQUIREMENTS

2.1 The basic requirements for storage of sugar in godown without deterioration is to minimize the ingress of moisture from all sides.

3. LOCATION

3.1 The godown shall be constructed on raised, well-drained ground, the level of which is higher than the ground level. Even in the extreme circumstances of heavy rain, water shall not stagnate near the godown or enter the godown through its openings.

3.2 The godown shall be located far away from spray ponds and in such a way that the prevailing wind direction does not carry the spray of moisture laden air to the godown. Other sources of moisture, such as exhaust blow off, boiler blow downs, condenser water channels and storm water drains should be led in the direction away from the godowns.

3.3 The godowns shall, as far as possible, be adjacent to the bagging house in a sugar factory. This facilitates the transport of bags to the godown.

3.4 As far as possible, the godown shall not be near the place where molasses are stored or where the press mud is discharged or where the effluents of the factory are let out. These are the places of intense activity of micro-organisms and serve as sources of contamination and spoilage of sugar.

3.5 The railway siding may pass near or by the side of the godown for easy handling.

3.6 The general location of the godown is given in Fig. 1.

4. CAPACITY AND DIMENSIONS

4.1 The capacity of the sugar godown for storing sugar bags, shall be roughly estimated at the rate of 100 kg per bag of sugar with a space volume of 0·150 m^3.

4.2 While estimating the height of stacks, care shall be taken to ensure that minimum space of about two metres is left between the top surface of the stack and the top of walls or the bottom of trusses employed for support of the roof. The height of the stack, however, depends upon the strength or load bearing capacity of jute bags used for storing sugar. For 'A' type of twill jute bags of good quality (*see* IS : 1943 - 1964*) the stack height may be up to 24 bags.

4.3 The length and breadth of the godown usually depends upon the size of the ground area available for construction. It is desirable, however, for the purposes of symmetry, that all godowns are of the same breadth and height in one factory. Table 1 gives the recommended capacities and dimensions of sugar godowns to store sugar bags. The capacities have been estimated on the basis of stacks being 24 bags high.

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*Specification for A-twill jute bags (*revised*).

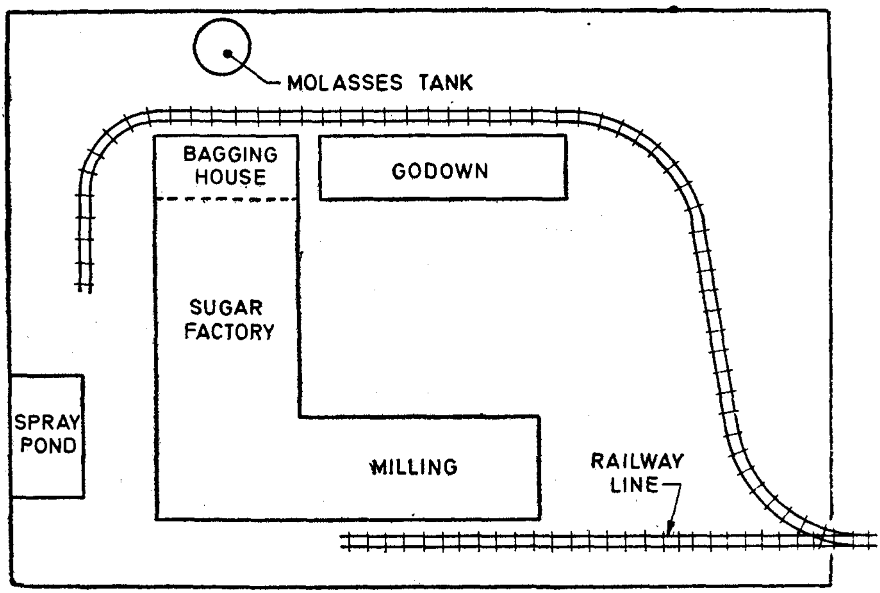

FIG. 1 GENERAL LOCATION OF A SUGAR GODOWN

TABLE 1 RECOMMENDED CAPACITIES AND DIMENSIONS FOR SUGAR GODOWNS (INTERNAL DIMENSIONS)

(*Clause* 4.3)

APPROXIMATE CAPACITY IN BAGS (1)	LENGTH (2)	BREADTH (3)	HEIGHT (4)
No.	m	m	m
20 000	50	13	10
30 000	75	13	10
40 000	100	13	10
50 000	120	13	10
60 000	150	13	10
70 000	170	13	10
80 000	200	13	10
20 000	30	20	10
30 000	45	20	10
40 000	60	20	10
50 000	75	20	10
60 000	90	20	10
70 000	105	20	10
80 000	120	20	10

5. STACKING

5.1 According to the capacity of the godown, the floor area shall be marked into rectangular or square stack spaces. Care shall be taken that all alleyways of at least one metre width are left between the stack and walls and about 1·5 metres in between the stacks. For the purpose of obtaining maximum capacity of the godown it is recommended that there should be one stack spreading lengthwise having one metre alleyway on all sides. For the sake of convenience each stack shall contain sugar of the same quality or grade (*see* IS : 498 - 1970*).

5.2 General plans for a typical sugar godown for stacking bagged sugar are suggested in Fig. 2.

5.3 The stack shall be so built that when completed, it is stable and perfectly cuboid in shape (*see* Fig. 3) and also that all peripheral bags on faces of the stack are in one plane or without any face of the stack bulging outward or inward at any point.

5.3.1 Sugar bags shall be stacked in a way so as to give the maximum strength to the stack. The stacking shall be done with one layer lengthwise and another breadthwise.

6. FOUNDATION

6.1 The foundation and column shall be designed as per IS : 1080 - 1980†.

7. PLINTH

7.1 It is desirable that the plinth level of the bagging houses is at the same height as that of the godown.

7.2 The plinth shall be generally kept 0·5 m or more above the ground level. The height of the plinth largely depends upon the subsoil water level. In the case of sub-mountainous and other low level areas the height of the plinth shall be at least one metre.

7.3 In case a railway siding is to be provided by the side of the structure, the height of the plinth shall be such as to have the platforms at a height as per railway requirements. The minimum width of platforms shall be 3 m for broad gauge and 2·5 m for metre gauge. To prevent rain water from getting inside the godown through doors, the platform shall be provided with a slope of 4 cm from the wall to its outer edge. In case no railway siding is to be provided by the side of the structure, the platform level shall be at least 0·5 m above the highest known flood level.

---

*Grading for vacuum pan sugar (plantation white) (*third revision*).

†Code of practice for design and construction of simple spread foundations (*first revision*).

7.4 Plinth Filling and Laying of Floor

7.4.1 The principal aim of the plinth is to prevent the creepage of moisture from subsoil water. Investigations show that lime mortor is more helpful in lessening the creepage of moisture than the cement mortar.

7.4.2 The first course of the plinth shall be of 75 mm rammed earth with interstices filled with lean cement concrete. Over this concrete, damp-proof treatment shall be provided. The preparatory work for the damp-proofing treatment shall be in accordance with provision as per IS: 3067 - 1966[1]. The damp-proofing treatment shall be laid using bitumen felt as laid down in IS : 1609 - 1976[2].

7.4.2.1 Over the damp-proofing treatment a 75 mm layer of well baked bricks (*see* IS : 1077 - 1976[3]) shall be laid flat. A layer of 75 mm thick lime concrete (*see* IS : 2541 - 1974[4]) or cement concrete (*see* IS : 2571 - 1970[5]) shall be provided over the brick layer followed by flooring.

NOTE — Lime concrete is preferable to cement concrete flooring.

8. FLOOR

8.1 The floor shall be cement-concrete (*see* IS : 2571 - 1970[5]) or brick flooring (*see* IS : 5766 - 1970[6]).

NOTE — Brick flooring is preferable to cement concrete flooring.

9. STRUCTURE

9.1 The godown shall be constructed as a framed structure consisting of reinforced cement-concrete columns and tie beams. The structure shall be designed in accordance with the provision given in IS : 456 - 1978[7].

---

[1] Code of practice for general design, details and preparatory work for damp-proofing and waterproofing of buildings.

[2] Code of practice for laying damp-proof treatment using bitumen felts (*second revision*).

[3] Specification for common burnt-clay building bricks (*third revision*).

[4] Code of practice for preparation and use of lime concrete (*first revision*).

[5] Code of practice for laying *in situ* cement concrete flooring (*first revision*).

[6] Code of practice for laying burnt clay brick flooring.

[7] Code of practice for plain and reinforced concrete (*third revision*).

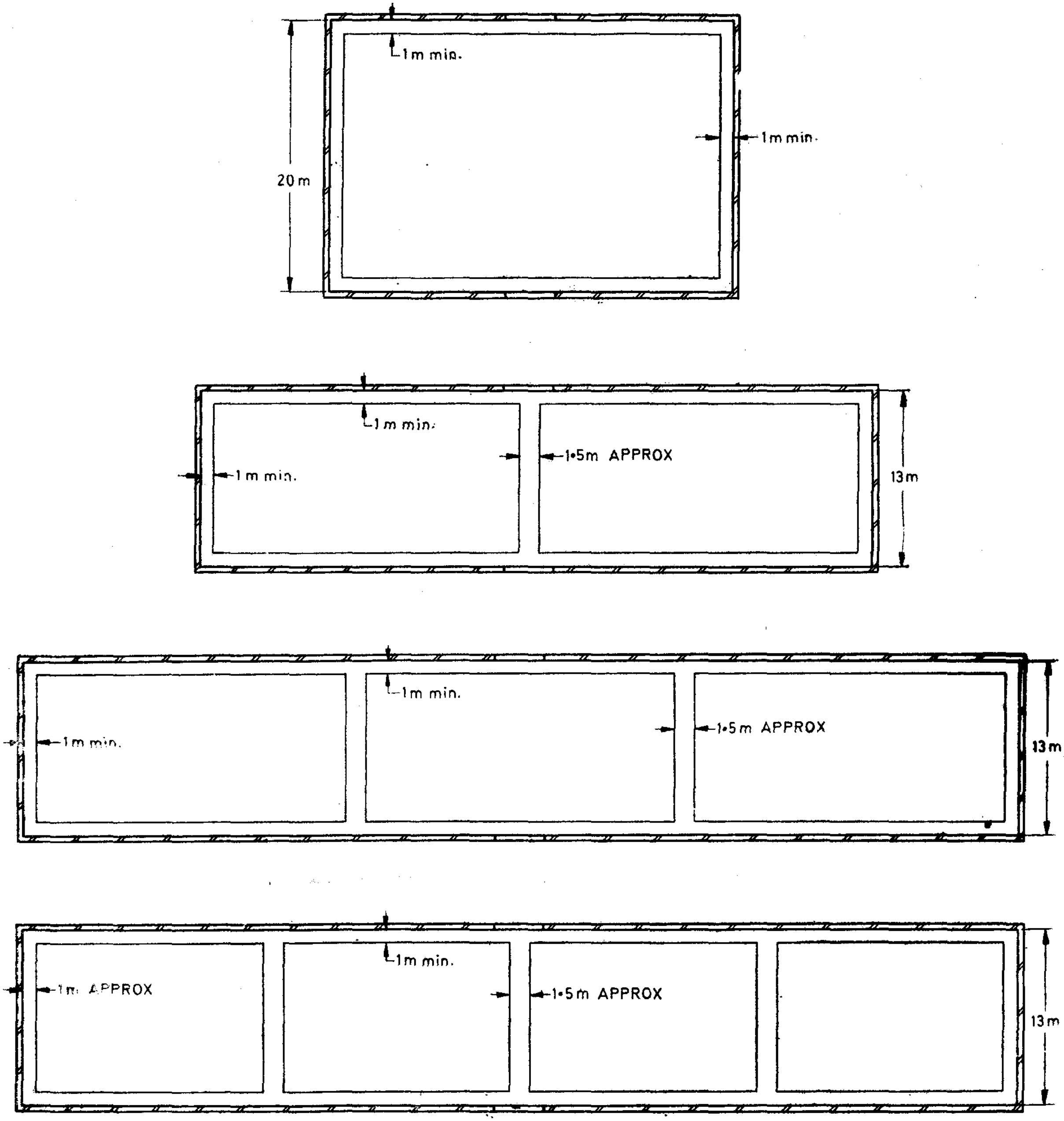

Fig. 2 Recommended Stacking Arrangements For 13-And 20-Metre Spans

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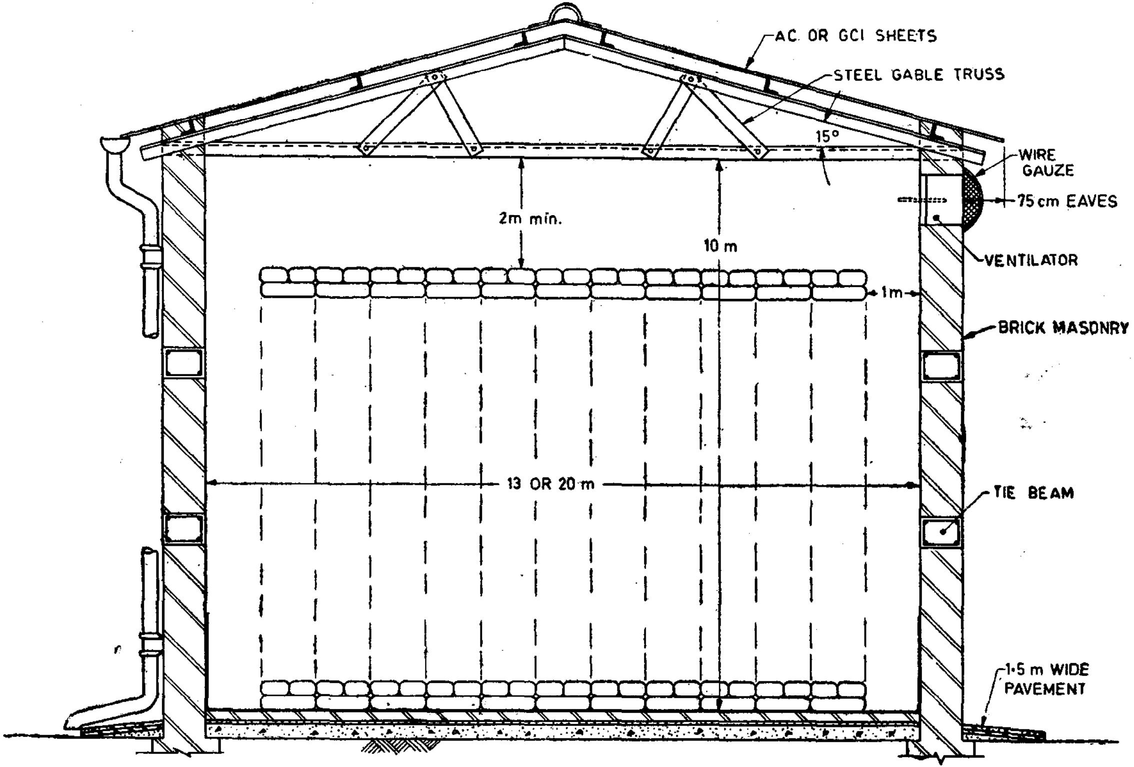

FIG. 3 SECTIONAL ELEVATION OF SUGAR GODOWN WITH SCHEMATIC STACKING (BASIS ONE STACK)

9.2 The walls shall be built of either stone masonry [*see* IS : 1597 (Part I) - 1967[1]] or bricks masonry (*see* IS : 2212 - 1962[2]) and shall be designed in accordance with the provision of IS : 1905 - 1980[3]. The thickness of the wall shall be 350 mm minimum. The joints between the columns and walls shall be properly sealed by grouting. The columns and wall shall be rendered smooth by plastering with lime mortar or cement mortar in accordance with the provision laid down in IS : 2394 - 1965[4] or IS : 1661 - 1972[5]. The walls may also be pointed where hollow blocks (*see* IS : 3952 - 1978[6]) are used, they shall be cement plastered on both sides.

10. RESISTANCE TO EARTHQUAKE

10.1 The godown shall be designed and constructed to take care of earthquake forces in accordance with the provision given in IS : 1893 - 1975[7] and IS : 4326 - 1976[8].

11. ANTI-TERMITE MEASURES

11.1 Anti-termite measures may be adopted in accordance with IS : 6313 - (Part I) - 1981[9] and IS : 6313 (Part II) - 1971[10].

12. DOORS

12.1 Ordinarily two doors shall be provided for each sugar godown. The doors shall be fitted with steel rolling shutters (*see* IS : 6248 - 1979[11]) on the outside and a sliding door on the inside (*see* Fig. 4).

12.2 Doors shall be of dimensions 3·7 × 3 m.

12.3 Doors shall have *CHHAJJA* of at least 1·2 × 5 m dimensions (*see* Fig. 4).

---

[1] Code of practice for construction of stone masonry : Part I Rubble stone masonry.

[2] Code of practice for brickwork.

[3] Code of practice for structural safety of buildings : Masonry walls (*second revision*).

[4] Code of practice for application of lime plaster finish.

[5] Code of practice for application of cement and cement-lime plaster finishes (*first revision*).

[6] Specification for burnt clay hollow blocks for walls and partitions (*first revision*).

[7] Criteria for earthquake resistant design of structures (*third revision*).

[8] Code of practice for earthquake resistant construction of building (*first revision*).

[9] Code of practice for anti-termite measures in buildings: Part I Constructional measures (*first revision*).

[10] Code of practice for anti-termite measures in buildings: Part II Pre-constructional chemical treatment measures.

[11] Specification for metal rolling shutters and rolling grills (*first revision*).

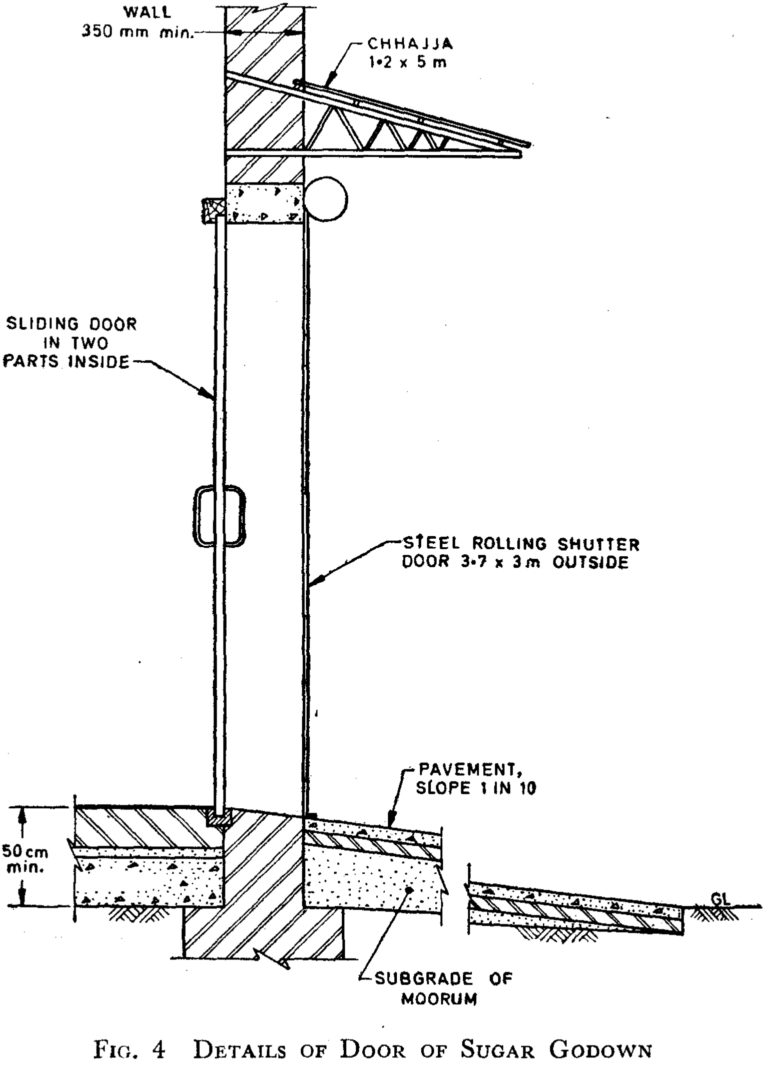

FIG. 4 DETAILS OF DOOR OF SUGAR GODOWN

12.4 An antechamber of dimensions 4·5 × 3·6 m shall be provided on the outside of the godown door to break the direct blast of air. Details are given in Fig. 5.

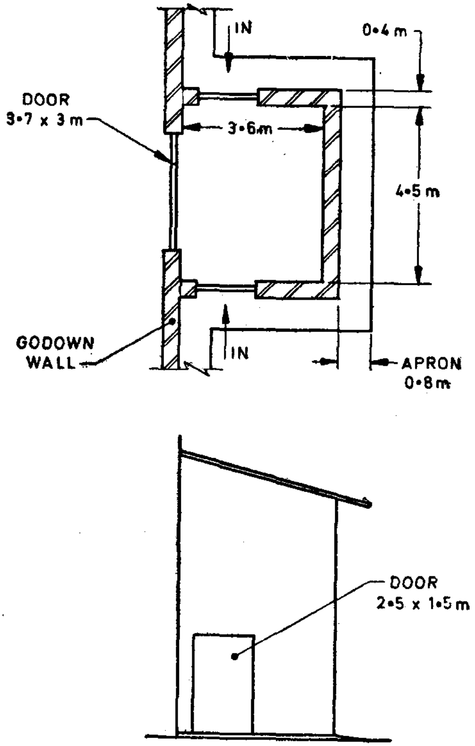

FIG. 5 DETAILS OF AN ANTECHAMBER

13. VENTILATORS

13.1 For every alternate bay, one ventilator either of steel or timber (*see* IS : 1038 - 1975[1]) and IS : 1003 (Part II) - 1966[2] of openings not less than 0·5 m in height and 1 m in width shall be provided. The ventilator shall be fixed 15 cm below the top edge of the wall as measured from outside. It shall be provided with a centrally pivoted rotating shutter. The frame of the ventilator shall be provided with a rubber lining so that the shutter will give a close fitting when closed without giving any chance of air and moisture leakage. The ventilators shall be provided with wire gauge 85 G, 0·560 mm diameter of wire (*see* IS : 1568 - 1970[1]) on the outside as shown in Fig. 3.

---

[1] Specification for steel doors, windows and ventilators (*second revision*).

[2] Specification for timber panelled and glazed shutters: Part II Window ventilator shutters (*first revision*).

14. ROOF

14.1 The roofing material shall be either corrugated asbestos cement sheets (AC) (*see* IS : 459 - 1970[2]) or galvanized corrugated steel sheets (GCI) (*see* IS : 277 - 1977[3]) laid over steel gable truss (*see* Fig. 3). The truss, shall be designed in accordance with, the provision given in IS : 875 - 1964[4] and IS : 800 - 1962[5]. The corrugated sheets shall be laid in accordance with the provision of IS : 3007 (Part I) - 1964[6].

NOTE — The use of G C I sheets is preferable to the use of A C sheets.

14.2 AC/GCI — The sheets shall project at least 0·75 m from the longitudinal walls. (Where there is recurrence of heavy hailstorms, the use of corrugated asbestos cement sheets may be avoided. The sheets shall overlap longitudinally at least by one and half corrugations. Asphalt impregnated hessian cloth of at least 10 cm width is interposed in the overlapping of sheets. The purlins and sheets shall be well anchored and secured. Bituminous washers shall be used for securing the sheets. In areas liable to excessive heat, use of heat reflecting paint on the top may be considered. Damp-proofing with bitumen felt shall be carried out on the entire roof of the sugar godown (*see* IS : 1346 - 1976[7]).

14.3 Where gabled roof is constructed, care shall be taken that no hollow space is left between walls and the roof covering.

15. DRAINAGE

15.1 The general requirement for the drainage of sugar godown shall be in accordance with IS : 1742 - 1972[8]. Rain-water pipes shall be provided at every alternate bay for drainage of rain-water from the roof (*see* IS : 2527 - 1963*). A rain-water gutter made of G I sheet or asbestos cement pipe of adequate size shall be fixed to the roof as shown in Fig. 3. The gutter shall open into the rain-water pipes of cast iron or cement and of adequate size. The pipes shall be properly secured at the off take and also securely fixed with clamps to the wall at every 2 m. The lower ends of the drain pipes shall be 15 cm above the ground level and shall be provided with shoes (*see* Fig. 3). The rain-water shall be drained off by suitable open drains 1·5 m away from the main structures.

---

[1] Specification for wire cloth for general purposes (*first revision*).

[2] Specification for unreinforced corrugated and semi-corrugated asbestos cement sheets (*second revision*).

[3] Specification for galvanized steel sheets (plain and corrugated) (*third revision*).

[4] Code of practice for structural safety of buildings: Loading standards.

[5] Code of practice for use of structural steel in general building construction (*revised*).

[6] Code of practice for laying of asbestos cement sheets: Part I Corrugated sheets.

[7] Code of practice for water proofing of roofs with bitumen felts (*second revision*).

[8] Code of practice for building drainage (*first revision*).

16. PAVEMENT

16.1 All around the structure, abutting the plinth, a pavement 1·5 m wide and about 17 cm thick shall be provided (*see* Fig. 3). The slope of the pavement shall be 1 in 10. It shall consist of a bed of brick or stone aggregate well consolidated to a thickness of 9 cm over a sub-grade of *MOORUM* and finished with 7·5 cm thick cement concrete (1 : 3 : 6).

17. ELECTRIC WIRING AND LIGHTING

17.1 Electric wiring installations shall conform to IS : 732 - 1982†. All wiring shall be of recessed metallic conduit type and only PVC cables conforming to IS : 694 - 1977‡ shall be used. No socket outlets shall be provided inside the godown.

17.2 The illumination level within the godown shall be not less than 100 lux. Only bulkhead type lighting fittings shall be used in the godown and they shall be fixed at least at a height of 5 m from the floor. All lights within the godown shall be controlled only by a double pole switch. This shall be installed at the outside of the main door so as to cut off the electric supply when the godown door is closed.

17.3 All light fittings shall be of ' Protected type ' (in which the lamp is enclosed by heat resisting toughened clean glass) and the same shall be mounted from the wall and not hung from the roof truss.

17.4 All the joints shall be made in proper joint boxes provided with the light fittings as given in **17.3**.

17.5 Arrangements should be provided for proper earthing of all electrical fittings. All electrical equipment at medium voltage shall be earthed by two separate and distinct connections with earth.

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*Code of practice for fixing rain-water gutters and downpipes for roof drainage.

†Code of practice for electrical wiring installations (system voltage not exceeding 650 volts) (*second revision*).

‡Specification for PVC insulated cables for working voltages up to and including 1 100 volts (*second revision*).

18. FIRE FIGHTING ARRANGEMENTS

18.1 The provision of fire extinguisher CO_2 type (*see* IS : 2878 - 1976*) shall be made. The scale and fixing of extinguisher shall be as per IS : 2190 - 1979†. The electrical installations inside and outside the godown shall be fixed to provide safety against fire in accordance with the provision given in IS : 1646 - 1961‡.

18.2 It is also advisable to make arrangements for an automatic fire alarm system as per IS : 2189 - 1976§.

---

*Specification for portable fire extinguishers, carbon-dioxide type (*first revision*).

†Code of practice for selection, installation and maintenance of portable first-aid fire extinguishers (*second revision*).

‡Code of practice for fire safety of buildings (general) : Electrical installations.

§Code of practice for installation of automatic fire alarm system using heat sensitive type fire detectors (*first revision*).

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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Western : Novelty Chambers, Grant Road	BOMBAY 400007	6 32 92 95
Eastern : 5 Chowringhee Approach	CALCUTTA 700072	27 50 90
Southern : C. I. T. Campus	MADRAS 600113	41 24 42
Northern : B69, Phase VII, Industrial Focal Point	S.A.S. NAGAR (MOHALI) 160051	8 78 26

Branch Offices:

'Pushpak', Nurmohamed Shaikh Marg, Khanpur	AHMADABAD 380001	2 03 91
'F' Block, Unity Bldg, Narasimharaja Square	BANGALORE 560002	22 48 05
Gangotri Complex, Bhadbhada Road, T. T. Nagar	BHOPAL 462003	6 27 16
22E Kalpana Area	BHUBANESHWAR 751014	5 36 27
5-8-56C L. N. Gupta Marg	HYDERABAD 500001	22 10 83
R 14 Yudhister Marg, C Scheme	JAIPUR 302005	6 98 32
117/418 B Sarvodaya Nagar	KANPUR 208005	4 72 92
Patliputra Industrial Estate	PATNA 800013	6 28 08
Hantex Bldg (2nd Floor), Rly Station Road	TRIVANDRUM 695001	32 27

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